

# GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD.

## ENGINEERING MECHANICS

### 1. RATIONALE

Engineering Mechanics is a branch of Applied Science where laws of physics are applied to solve engineering problems. Broadly speaking Engineering Mechanics can be classified in two categories-Static and Dynamics.

In this course, an attempt has been made to apply different laws of science to solve Static and Kinematic problems. An attempt is also made to strengthen the knowledge of students, so as to make the path for applied technology subjects smoother and logical.

### 2. TEACHING SCHEME

<b>Sr. No.</b>	<b>Topic</b>	<b>TH Hrs.</b>	<b>PR Hrs.</b>	<b>Total Hrs.</b>
1.	Introduction	01	—	01
2.	Coplanar concurrent forces	08	06	14
3.	Coplanar parallel and non concurrent forces	06	06	12
4.	Centroid & centre of gravity	04	02	06
5.	Friction	04	04	08
6.	Rectilinear motion	04	02	06
7.	Motion of projectile	02	—	02
8.	Curvilinear motion - centripetal force	05	—	05
9.	Engineering applications of work, power and energy	04	—	04
10.	Simple Machines	04	08	12
	<b>Total Hrs.</b>	<b>42</b>	<b>28</b>	<b>70</b>

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### **3. OBJECTIVES :**

1. Explain the term: vector and scalar, giving examples of each.
2. Explain different system of Units.
3. Explain various system of forces and transmissibility and superposition of forces.
4. Develop the concept of Resultant and equilibrant using parallelogram of forces
5. Develop the concept of composition and Resolution of force.
6. Explain graphical methods, Lami's theorem.
7. Develop the concept of Moment and Couple
8. Explain statically determinate beams and reactions.
9. Distinguish between Centroid and Centre of Gravity.
10. Develop the concept of moment of area.
11. Develop the concept & phenomenon of friction & various terms related to it.
12. Develop the concept of rectilinear motion & V-T diagram.
13. Explain the principles related to motion of projectile & engineering problems related to trajectory of projectile.
14. Explain the concepts & principles related to Curvilinear motion.
15. Explain importance of centripetal & centrifugal force, superelevation, wheel reactions, skidding, overturning of vehicle moving on a level path.
16. Explain the concept of Work, Power & Energy.
17. Explain the method of computing work, power of typical engines, K.E. and P.E.
18. Explain & develop the concept of working of various simple machines & different terms related to it.
19. Explain law of machines & develop the concept of reversibility of machines, reversible & non-reversible machines.

### **4. TOPICS AND SUB TOPICS :**

#### **TOPIC 1 : INTRODUCTION**

**1 Hrs.**

- 1.1 Scalar and Vector quantities.
- 1.2 Scope of Engg. Mechanics.
  - Static
  - Dynamics (a) Kinetics (b) Kinematics
- 1.3 Different systems of units-Conversions-, Abbreviations.

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## **TOPIC 2 : COPLANAR CONCURRENT FORCES : 8 HRS.**

- 2.1 Forces, Units of Force, elements, Principles of superposition, Principle of transmissibility.
- 2.2 Composition and resolution of forces, Resultant conditions of equilibrium, Analytical and graphical method, Law of parallelogram of forces, law of triangle of forces, law of polygon of forces, Lami's theorem-problems.

## **TOPIC 3 : COPLANAR – PARALLEL AND NON–CONCURRENT FORCES 6 HRS.**

- 3.1 Moment, Couple. Principle of moment, application. Properties of Couples, numerical problems.
- 3.2 Conditions of Equilibrium.
- 3.3 Reactions in Beams.
  - Statically Determinate beams
  - Types of supports
  - Types of Loading
  - Problems.

## **TOPIC 4 : CENTROID AND CENTRE OF GRAVITY 4 HRS.**

- 4.1 Centroid
  - Centroid of Standard shape
  - Indian standard sections - I,C,II,L,O, Triangular Section.
  - Axis of symmetry
  - Theorem of Moment
  - Problems.
- 4.2 Centre of Gravity.
  - Centre of Gravity of standard solids.
  - Axis of symmetry
  - Theorem of Moment
  - Problems.

## **TOPIC 5 : FRICTION 4 HRS.**

- 5.1 Friction, Laws of friction, Coefficient of friction, Angle of friction, Angle of Repose
  - Types of friction
  - Coefficient of friction and its effect.
- 5.2 Application of Lami's theorem and theory of resolution of forces.
  - Laws of friction to Screw jacks.

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### TOPIC 6 : RECTILINEAR MOTION : 4 HRS.

- 6.1 Kinetics, Kinematics.
- Velocity, Average Velocity, Uniform Velocity, Speed, Displacement, Acceleration, Retardation.
  - $v = u + at$ ,  $v^2 = u^2 + 2as$ ,  $s = ut + \frac{1}{2}at^2$
- 6.2 Draw V-T diagram.
- Problems, motion under gravity.

### TOPIC 7 : MOTION OF PROJECTILES : 2 HRS.

- 7.1 Trajectory range, maximum range, angle of projection, time of flight, Maximum height different equations of projectile.
- 7.2 Engineering problems.

### TOPIC 8 : CURVILINEAR MOTION- CENTRIPETAL FORCE : 5 HRS.

- 8.1 Angular displacement, Angular velocity, angular acceleration and retardation, tangential velocity, equations.
- 8.2 Problems
- 8.3 Centripetal and Centrifugal forces.
- Skidding, overturning, thrust on rails.
  - Engg. problems
  - Importance of superelevation
  - Expression for superelevation.
  - Problems.

### TOPIC 9 : WORK-POWER- ENERGY 4 HRS.

- 9.1 Work
- Workdone, force-displacement diagram Workdone in stretching the compound spring Torque, workdone by torque.
- 9.2 Power
- I.H.P., B.H.P. of engine
  - Equation of H.P. in terms of torque and R.P.M.
  - Engineering Problems on it.
- 9.3 Energy Kinetic and potential energy & Engg. problems on it

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## TOPIC 10 : SIMPLE MACHINES :

4 HRS.

- 10.1 Mechanical Advantage, V.R., Efficiency, line sketch of different systems of pulley blocks, simple and compound levers, simple machines, problems.
- 10.2 Laws of Machines.
- 10.3 Reversible, Non-reversible machines.

## 5. LABORATORY EXPERIENCES

### Sr. No. Name of Experiments

- 1. Law of parallelogram of forces.
- 2. Law of Triangle of forces ( Lamy's theorem, Unknown weight)
- 3. Law of polygon of forces.
- 4. Law of parallel Forces. (Reactions of Beam-couple)
- 5. Centroid of given lamina
- 6. Law of machine of given machine. Simple screw jack.  
(Analytically, graphically)
- 7. Verify velocity ratio for different simple machine.  
(1) Wheel - Axle (2) Simple purchase crab.  
(3) Simple screw jack.
- 8. Determine M.A., efficiency,  $E_f$ ,  $F$ , for double purchase crab.
- 9. Draw and study of graph for wheel and different axle.  
(a)  $W - P$  (b)  $W - n$  (c)  $W - Pf$  (d)  $W - F$ .
- 10. Draw  $V - T$  diagrams for different combinations of (a) Velocities  
(b) Uniform accelerations as well as (c) Uniform retardations
- 11. Demonstration of Non - concurrent Non parallel forces. (Funicular diagram.)

## 6. REFERENCES :

- 1. Applied Mechanics - by R.S.Khurmi.
- 2. Applied Mechanics - by Dadhe, Jamdar & Walavalkar.
- 3. Engineering Mechanics - by S.B.Junarkar.  
For Diploma Students
- 4. Applied Mechanics - by I.B.Prasad.
- 5. Applied Mechanics - by Ramamrutham.

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### 7. ASSESSMENT SCHEME :

<b>Sr. No.</b>	<b>Topic</b>	<b>Percentage weightage</b>
1.	Introduction	05
2.	Coplanar concurrent Forces	15
3.	Coplanar parallel and non concurrent forces	15
4.	Centroid & centre of gravity	10
5.	Friction	10
6.	Rectilinear motion	05
7.	Motion of projectile	05
8.	Curvilinear motion - centripetal force	10
9.	Engineering applications of work, power and energy	10
10.	Simple Machines	15
	<b>Total</b>	<b>100</b>